“At the Crossroads”
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Good morning everyone. Thank you for being here.

As you know, the space industry is in the midst of incredible change. Former adversaries are now partners in the drive to send humans into the depths of space.

I am pleased to speak to you today, because I strongly believe that the new millennium has the potential to be the space millennium.

Notice that I said “the potential to be the space millennium.” For if we do not rise to the challenges before us, space activities may not be as prominent in the 21st century as we would like them to be.

We are at what Intel’s Andy Grove calls an inflection point—the point at which “the old strategic picture dissolves and gives way to the new.“ And that new strategic picture can take a business even higher, or it can ruin a company.

This is where the space business is today. The decisions we make at this inflection point will determine our future success or failure in space.

And make no mistake, there is incredible potential.

First, peaceful exploration of space could be the model for maintaining peace on Earth.

Second, space activities and technologies could dramatically expand global business and drive the world’s economic engine into the next century and beyond.

The economic opportunities space provides might enrich the people of Earth, and the technologies we develop could dramatically improve the lives of people around the world.

But we must rise to the challenge before us.

Let me give you just one example.

Right now, there are about 1 billion phones on Earth for about 6 billion people. And even at that, some estimate only about half of the world's people have ever used a phone.

At the same time, there are only about 100 million Internet terminals in the world. But it is projected that there will be 1 billion around 2010 – equal to the number of phones in just 10 years.

And remember, that's just terminals connected to the Internet. Think about how many people have computers and aren't on-line…yet.

Despite that, there will still be as many Internet terminals as there are telephones. Amazing.

That helps to explain the explosive growth of Internet companies. It also tells us that there will be an explosion in the bandwidth used by those terminals and in the delivery of data and services. Economic opportunity abounds.

But to be an essential part of the explosion, space companies will need to be much more competitive and compatible with terrestrial technologies. So far, space industries have been too sluggish in mobile and broadband services. And we're getting whipped.

Think about it. PCS service costs pennies a minute, while mobile space communication costs dollars per minute.

And the ground-based mobile and fixed communications terminals are getting smaller and cheaper. In fact, in some instances they are being given away as part of the service agreement. Yet space systems are still large and expensive.

Terrestrial companies are offering better service at lower costs, because they are leveraging technologies to their advantage much faster.

Just imagine the economic possibilities for space companies that can do the same thing. And remember that we may have lost some of the battles, but we haven't lost the war.

Now there is no question that we face barriers to our growth.

For instance, the space sector is lagging behind in developing interconnective technologies and applying them to broad commercial uses. That's why many companies are facing financial crises.

Simply providing unique services without interconnectivity could be the kiss of death for businesses.

A decade ago, the big advantage of satellite communications was in broad bandwidth and rapid infrastructure deployment to rural areas. Telephone lines were operating at about 64 Kilobits per second, and special high-speed lines at 1.5 Megabits per second could be leased. Meanwhile, satellite communications promised Gigabits/sec.

But today terrestrial communications lines are no longer fixed bandwidth. Companies provide bandwidth on demand, and1.5 Megabits per second is routinely available.

To the dismay of those of us in this room, the vision of satellite communications displacing ground lines has not occurred.

Now they're throwing in the Internet, and the entire playing field has changed.

The land is laced with a vast ground network into many homes. More than 100 Kilobits per second is nothing special. Fiber optics is more and more commonplace, and television cable will soon make 10 Megabits per second routine.

The competition doesn't stop there: Internet II promises up to Gigabits per second.

So these are the challenges for the satellite communications industry to surge forward:

(1) Interoperability: we need to develop standards and protocols that work seamlessly for voice, data and video – just like and with terrestrial communications.

(2) Quality of service: Satellite services must be comparable to the best fiber optic lines, they must network seamlessly with ground networks, and mobile services must be clear, available, and compatible with ground systems for switch over. That means 24-hour availability and close to 100% reliability—assured anytime, any where, interruption and interference free

(3) Cost must be competitive with terrestrial communication services. This means the space communications industry must integrate advanced technologies into operational systems, with a much shorter cycle time from concept to deployment.

(4) Latency must be addressed for geo-synchronous satellites: Current geo-synchronous satellites are latency independent, because they deliver entertainment and data. When the Internet demands synchronization of voice, video, and data, we cannot tolerate the 1/2-second time delay in sending the signal up and down. Radical new approaches must be found. If

we switch to MEO and LEO service to solve latency issues, we must still aggressively address cost, reliability, and availability of service. We must take an integrated approach.

However, there are success stories of how we have met challenges that many said were insurmountable.

In 1993, NASA launched the Advanced Communications Technology Satellite (ACTS) into geosynchronous orbit. It was the first commercial demonstration of Ka-band communications in the U.S. I salute the Europeans and Japan for already having launched Ka band payloads.

ACTS demonstrated what we can do when we set our minds and our resources to advancing technology to meet the needs of the future. Since ACTS, there have been over a dozen (15) Ka-band filings in U.S. alone and about twice that many in other parts of the world.

Some of the things we have done with ACTS are clearly leading the way for the next generation of space communication satellites.

ACTS operates at up to 622 Megabits/sec and has demonstrated the ability to limit errors to one bit in a trillion. This is exceptional performance. Even better than most ground networks, which only operate at up to 2/3 the speed and have 10 to 100 times more errors.

By comparison current GEO communications is limited to about 100 Megabits/sec with error rates of about 1 bit in a billion.

Also, unlike conventional communications satellites, which broadcast a single beam across an area the size of a continent, ACTS can distribute many smaller targeted beams—each about the size of New Jersey--providing much greater simultaneous coverage.

ACTS' on-board processing provides a switchboard in the sky that supports single hop digital links. This enables a direct path between ground points controlled by the satellite; no need to go through a ground based switching center, unless commercial requirements dictate it. And we demonstrated very small aperture terminals about the size of a Direct TV dish, making this capability much more convenient and cost effective.

NASA is doing its part but we are looking to the commercial community to carry the bulk of the load from here. In spite of what ACTS has done, ground systems are advancing at the speed of light. Global networks, interoperability, and multi-Gigabit data rates are what they offer. The future for space communications is not set in stone. The challenges are great, and it is up to all of us to meet them.

Beyond developing interconnected systems and deploying lower cost constellations in much shorter times, we must also significantly reduce the cost of launching those systems. There is no way we will be able to compete with terrestrial technologies if we don't dramatically reduce launch cost.

NASA is deeply committed to developing breakthrough technologies that will dramatically increase reliability and reduce cost. And we encourage the private sector to work on them too.

As we break through the barriers of interconnectivity, quality of service, cost, and latency, we will begin to realize the incredible potential of commercial space communications.

Another area ripe for development is people in space. And just last year, 16 nations joined together to pursue this opportunity.

The International Space Station draws on our long history of cooperation in space with Canada, Europe, and Japan. It strengthens ties with emerging space programs. And, perhaps just as importantly, the ISS facilitates the move from hostile competition to mutual collaboration with Russia.

On the ISS, we have robotics, launch, laboratories, and ground support provided by multiple nations. An international crew will inhabit the ISS beginning next spring and begin to conduct world-class research.

Some of that research will deal with the health of our astronauts during long-term space missions. We will develop health protocols for the microgravity environment.

We may also be able to seize opportunities in emerging areas like remote sensing. NASA is purchasing science data from commercial sources where they meet our research needs.

The only stipulation is that industry deliver the data we want, to the quality standards we specify and for significantly lower costs that our conventional satellite builds. This can only occur if companies build a strong and broad commercial customer base outside the federal government and truly commercialize space.

I'm sure you will hear a lot more about the opportunities in remote sensing during the next panel.

Where do we go from here?

I would like to share with you a vision of the 21st century. It is a vision of a future world with nations and industry sharing responsibilities, opportunities and challenges through peaceful interaction in civil space endeavors.

We will surround the globe with a network of Earth-observing spacecraft that will provide continuous, long-term information on climate change. They will detect and help mitigate natural disasters across the globe, such as forest fires, hurricanes and volcanic eruptions. And they will monitor commercial and natural resources such as farm production and fish migration. Some of these assets will be NASA's, a minimal number, and some may be commercial spacecraft linked into the Web.

We will intensify our investigations within our own Solar System. Increasingly intelligent robotic probes may plunge deeply beneath the icy surface of Europa. And we could sample material along dry riverbeds and seas on Mars, and bore beneath the dry Martian surface, bringing samples back to Earth for sophisticated analysis.

Eventually we will send humans to Mars and beyond.

Just imagine the revolutionary new technologies we need to develop if we hope to reach these ambitious goals. We will need small, highly efficient instruments and robots that can operate autonomously, handle unforeseen problems, decide what data to take and when to take it, and reduce this data to useful information products to send back to Earth. And we will be doing this in some of the harshest environments imaginable.

Now let these systems work for us on Earth. They will support our space assets in all phases of climate modeling, resource location, and helping us with natural disasters. Scores of these smart sensors and their intelligent information networks will provide us invaluable information to keep out lives safer—without ever placing a human at risk.

And when we can explore and monitor planets millions of miles from Earth, exploring and monitoring our own planet is almost child's play.

Imagine the new markets that these technologies could generate.

Yes, the new millennium could well be the space millennium. But only if we make the right decisions at this inflection point.

The future of the space frontier can make the third millennium a magnificent time of achievement for humankind. We all know the tremendous power and potential of the technologies we work with on a daily basis. They have been the foundation for an unprecedented

expansion of new business opportunities and improved quality of life for people around the world.

We all know technology has the power to improve society and the power to endanger it.

All the benefits of decades of work to open the space frontier by governments, industry, brilliant scientists and engineers from around the globe …

All the advances in the economic well-being and quality of life of people around the world that space has provided can fall apart . . .

All because some individuals, some companies, some governments…choose not to stop those who would violate the Missile Technology Control Regime and related norms. Instead they end up allowing the use key technologies to destabilize others, and to destroy economic and social opportunity.

Let us not be naïve to ignore the troubling signs. Let us not pretend danger may not lurk around the corner.

Let us not turn our backs when there is exploitation for commercial gain.

If we are united in this commitment, we can isolate and minimize the threat.

We in the US also realize that adherence to nonproliferation norms may add a hurdle for businesses.

I had the privilege of serving as President Clinton's Representative at the Paris Air Show in June of this year. A common concern expressed to me by both U.S. industry, foreign corporations and foreign governments was that in our vigilant efforts to protect global security, U.S. export law is adversely affecting business opportunities. As you may have heard here this week, the U.S. Government is working to address those concerns. But we will do it in a way that fully supports international norms on nonproliferation and combats threats to security. Without balanced enforcement, we resign ourselves to a more unstable world.

Let me be very clear.

Fundamental to global space cooperation and international business development is adherence to MTCR and related nonproliferation norms.

The space industry faces a crucial inflection point today because of technical, economic, and political obstacles. To overcome them, we have to make hard decisions about where we want to go in the future.

Like many of you, I got into the space industry because we go where no one has gone before and do things no one else does.

Think about that when you face these critical decisions.

When I think about those decisions, I can't help but think about my grandchildren Zachary and Jessica. And I think about the kind of future I want for them.

Look into your children's and grandchildren's eyes before you make decisions that will effect the next generation.

The decisions we make—big and small--will determine humankind's destiny in space in the 21st century.

Will we give up on the dreams we had a decade ago?

Or will we work together to achieve our dreams and take the space industry to new heights?

The time is now.

And the decision is ours.

Thank you very much.